SECTION 4

Diversion Structures

Diversion structures are composed of the pipes, intake and discharge structures, and pumps that deliver water from the Mississippi River into Bayou Lafourche or the bypass channel. These facilities require a site along the river that will provide the necessary access for the diversion works and has suitable geotechnical properties for foundation support. The diversion structure will include appropriate sediment removal facilities.

4.1 Hydraulic Planning Criteria

4.1.1 Flow Ranges for Facility Sizing

As described in Section 3, flows for the various alternatives ranged from 215 to 3,100 cfs. Because of this wide range of flows and the multitude of project alternatives, a parametric approach was taken to configure the diversion facilities. Facility configurations and cost estimates were prepared for a set of pump station capacities. From these data, cost curves and facility sizing were developed according to variations in design flow. Table 4-1 summarizes the number and sizes of pumps assumed for the various flow conditions used in the parametric analysis.

TABLE 4-1
Pumping Unit Configurations
Mississippi River Reintroduction into Bayou Lafourche – Phase 1 Design Report

Pump Station Capacity (cfs)	No. of 50-cfs Pumps	No. of 100-cfs Pumps	No. of 200-cfs Pumps	No. of 250-cfs Pumps	No. of 300-cfs Pumps	No. of 400-cfs Pumps
200	4	--	--	--	--	--
500	2	2	1	--	--	--
1,000	2	3	3	--	--	--
1,500	--	--	--	6	--	--
2,000	--	2	3	--	4	-
3,000	--	2	2	--	--	6

4.1.2 Mississippi River Stages

Mississippi River stage data are based on daily stage records from January 1951 to June 2004. Pump selections and power consumption estimates were based on the average monthly stage data shown on Figure 4-1. The minimum and maximum recorded river stages for each month since 1951 are also shown. Additional river stage elevation statistics are provided in Appendix F.

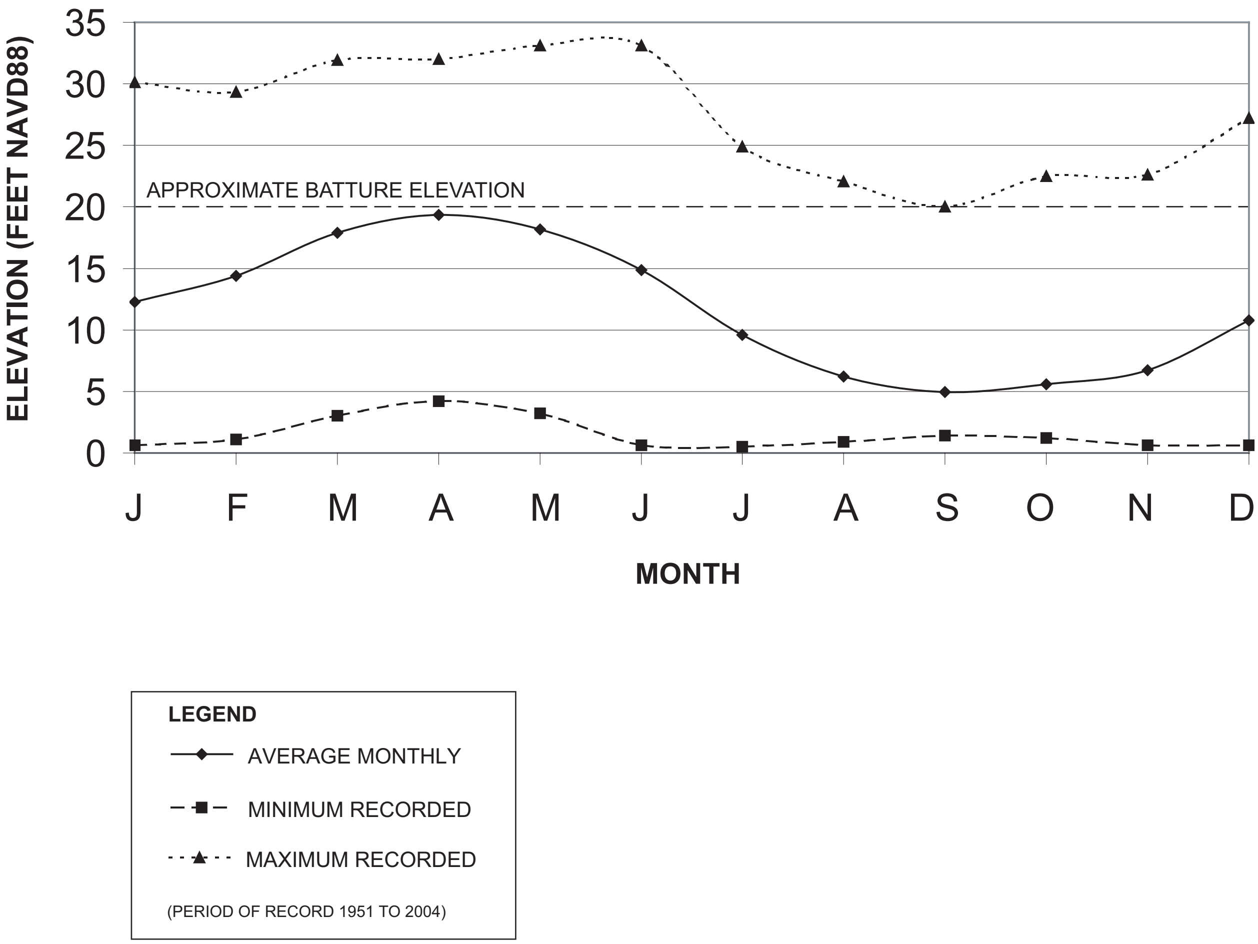

FIGURE 4-1
MISSISSIPPI RIVER STAGE DATA
MISSISSIPPI RIVER REINTRODUCTION INTO BAYOU LAFOURCHE
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4.2 Diversion Site Locations

Potential locations for water reintroduction structures were identified through a site reconnaissance, review of USGS topographic maps and aerial photographs, and discussions with the USACE and the Bayou Lafourche LFWD. The existing pump station is located at RM 175.5 on the Mississippi River in Donaldsonville. It was constructed in the 1950s to supply Mississippi River water into Bayou Lafourche. This pump station is located on the river side of the levee. Using the range of potential future flows that have been examined in this study (from 200 to 3,000 cfs), there is sufficient space adjacent to the downstream side of the existing pump station to construct another facility that would discharge into the existing channel of Bayou Lafourche, or to modify or rehabilitate the existing pump station. The Donaldsonville site location is shown on Figure 4-2.

Existing structures along Bayou Lafourche in the Donaldsonville area might restrict the existing channel capacity at high flows, so two additional locations on the Mississippi River were identified where reintroduction structures could be constructed. Each of these sites would have a new pump station that would discharge into a new open-channel bypass. Only one of the alternative sites would be implemented. However, the existing pump station at Donaldsonville would remain in service at 100 cfs in the future to ensure that water supply and water quality requirements are met in Bayou Lafourche, upstream of a bypass channel.

The primary two criteria for identifying potential reintroduction facility locations were Mississippi River hydraulics and the availability of open agricultural land for the new conveyance channels. Bathymetry for the river indicates that the sites are feasible. In addition, outside bends of rivers have the deepest channels and the least potential for sediment deposition. These characteristics are generally favorable for intake structures; the deep channel allows water to access the pump station during low river stages, and the low potential for sediment deposition minimizes sediment movement into the pump station.

The most favorable site was upstream of the existing pump station at Smoke Bend (see Figure 4-3). Located at RM 177.5, this site is on the outside of a large bend in the Mississippi River. The elevation of the batture (i.e., landscape on the river side of the levee) ranges from 20 to 22 feet, with the top of the existing levee at approximately 37 feet. At this location, a new reintroduction structure could be constructed on the river side of the levee on the batture, similar to the existing pump station. Currently, the batture is heavily vegetated at this location with brush and trees. On the land side of the levee, a two-lane highway and railroad track must be crossed before the agricultural sugarcane field could be reached.

4.3 Intake Alternatives

Two intake alternatives are applicable to the three pump station sites investigated for this Phase 1 Design Report. The intake connects the source water (Mississippi River) to the pump wetwell and determines how much sediment is carried into the Bayou Lafourche system. Sediment control is a key function of the intake because a large portion of the

FIGURE 4-2
DONALDSONVILLE DIVERSION LOCATION
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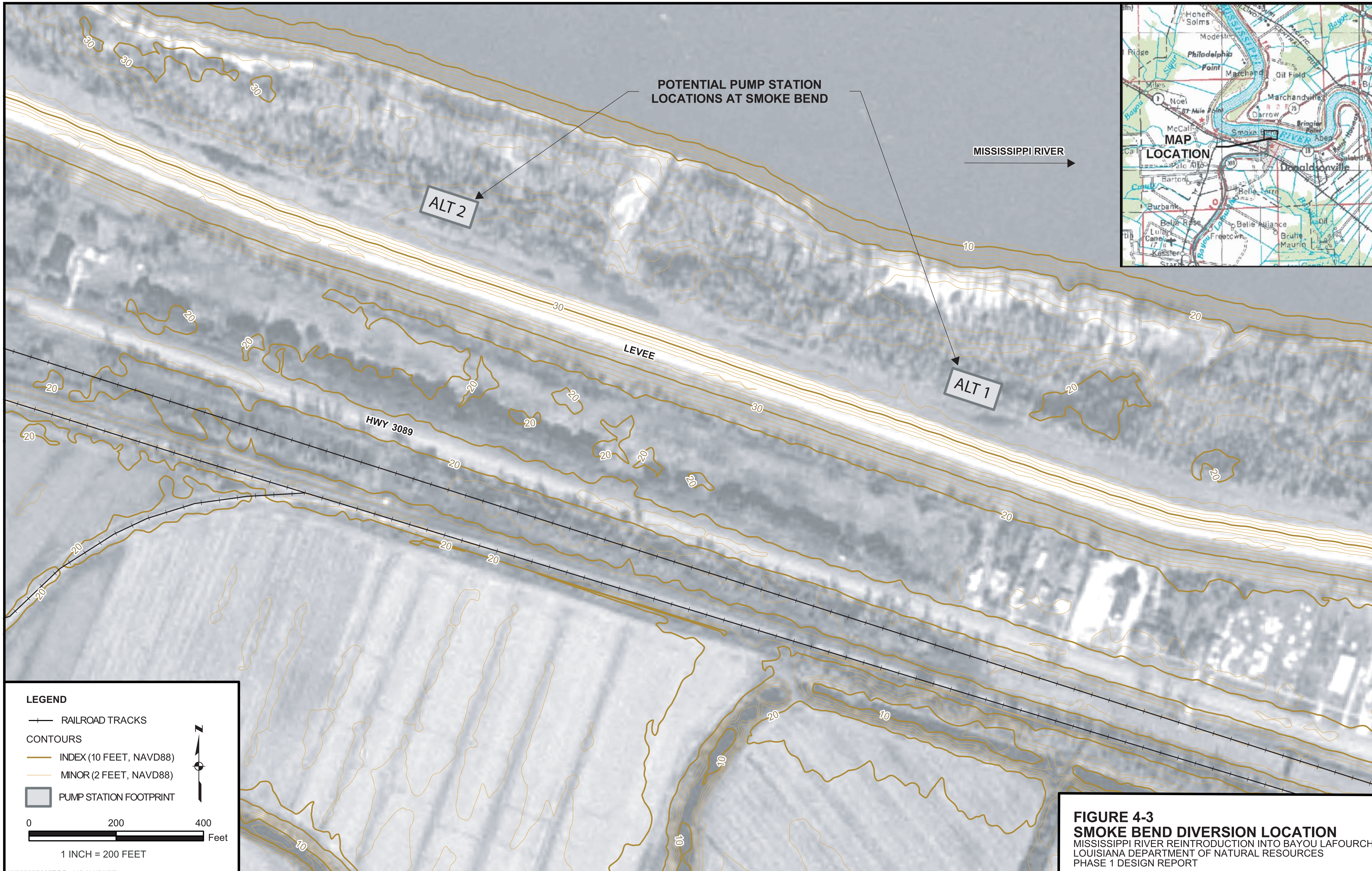

FIGURE 4-3
SMOKE BEND DIVERSION LOCATION
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sediment conveyed into Bayou Lafourche will ultimately be dredged, and higher concentrations of sediment and sand will also increase the wear on the impellers and bowls of the pump.

4.3.1 Piped Intake

A piped intake at the new pump station would be similar to the existing Donaldsonville pump station intake. Mississippi River water is drawn through this intake piping to the pump station wetwell. Figures 4-4 and 4-5 show a typical intake piping system, both in profile and in plan.

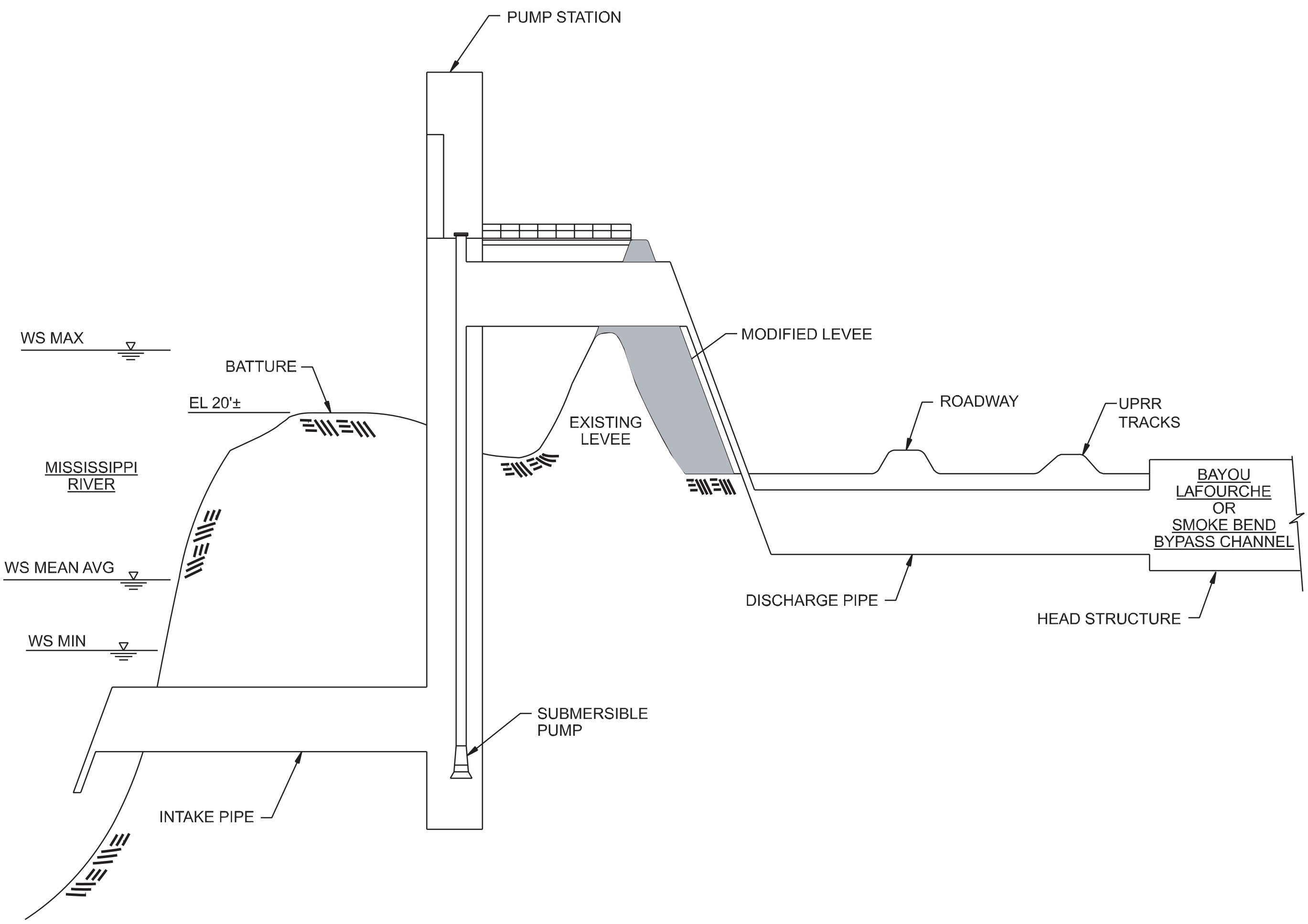
Because various flow alternatives were considered during the Phase 1 design process, each intake pipe was sized to convey water to a respective pump at a velocity of about 5 fps at design flows. For this evaluation, Table 4-2 lists the intake pipe sizes and velocities used for each nominal pump size. As final alternatives are developed and pump station flow rates determined, consideration will be given to fewer, but larger, intake pipes.

TABLE 4-2
Pump and Intake Piping Configurations
Mississippi River Reintroduction into Bayou Lafourche – Phase 1 Design Report

Pump Size (cfs)	Intake Pipe Diameter (inches)	Intake Pipe Velocity (fps)
50	42	5.2
100	60	5.1
200	84	5.2
250	96	5.0
300	102	5.3
400	120	5.1

The invert elevation of the intake piping will be established by the low river stage elevation to ensure that the intake pipe can provide adequate flow capacity to the wetwell. Ideally, the inlet of the intake pipe would always be fully submerged, so that vortices do not form above the inlet opening and draw air into the intake piping. Vortexing is further reduced by turning the intake piping down and making the inlet opening parallel to the water surface. The depth of the inlet is also influenced by the sediment gradient of the river, because typically, the higher an inlet is located in a river, the less sediment is drawn into the pumping system. The optimum invert will be evaluated further after bathymetric surveys are completed for the pump station sites to be investigated for the 30 percent design.

Intake pipe inlets are typically located out in the river flow and are at risk for damage by river traffic. Navigational lights and a visible structure protruding above the normal river stage minimize the possibility of a collision. The structure also supports the suspended intake pipe in the river and protects it from submerged logs and debris floating down the river.



TYPICAL PIPED INTAKE, RIVERSIDE PUMP STATION, OVER-LEVEE DISCHARGE PIPING

FIGURE 4-4
PUMP STATION PROFILE NO. 1
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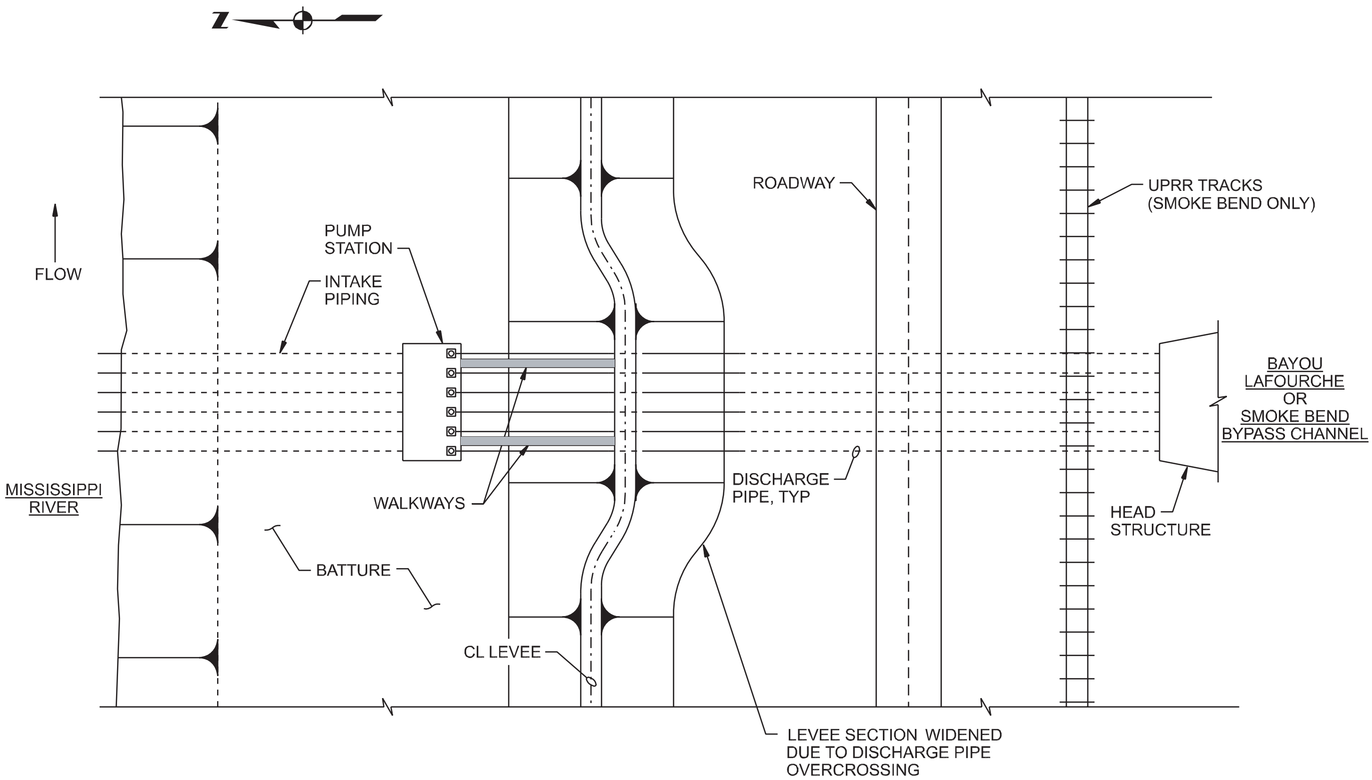

FIGURE 4-5
PUMP STATION SITE PLAN NO. 1
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4.3.2 Forebay Intake

In comparison to the piped intake, a forebay intake provides an open water channel to the pump station wetwell. The forebay's main advantage over a piped intake is the added functionality of sediment management for the Bayou Lafourche system. The open-channel configuration can be designed to enhance settling of material in the forebay and then the removal of that material. Figures 4-6 and 4-7 show a typical forebay intake, both in profile and in plan. The plan view shows both a straight-walled forebay and a flared forebay.

To reduce the amount of sediment being carried into Bayou Lafourche and ultimately being dredged, the forebay intake is designed to act as a sand and sediment trap. Depending on the hydraulic flow alternatives evaluated as part of the HEC-RAS analyses, Bayou Lafourche flow velocities range from 0.3 to 2.2 fps. To maximize sediment removal for the alternatives that are evaluated at the 30 percent level, the forebay intake could be designed for a velocity lower than flow velocities in Bayou Lafourche.

The forebay will require periodic dredging, whether the dredged material is discharged back into the Mississippi River or removed by way of the batture. In either case, because of accessibility, dredging at this location is less costly than dredging Bayou Lafourche.

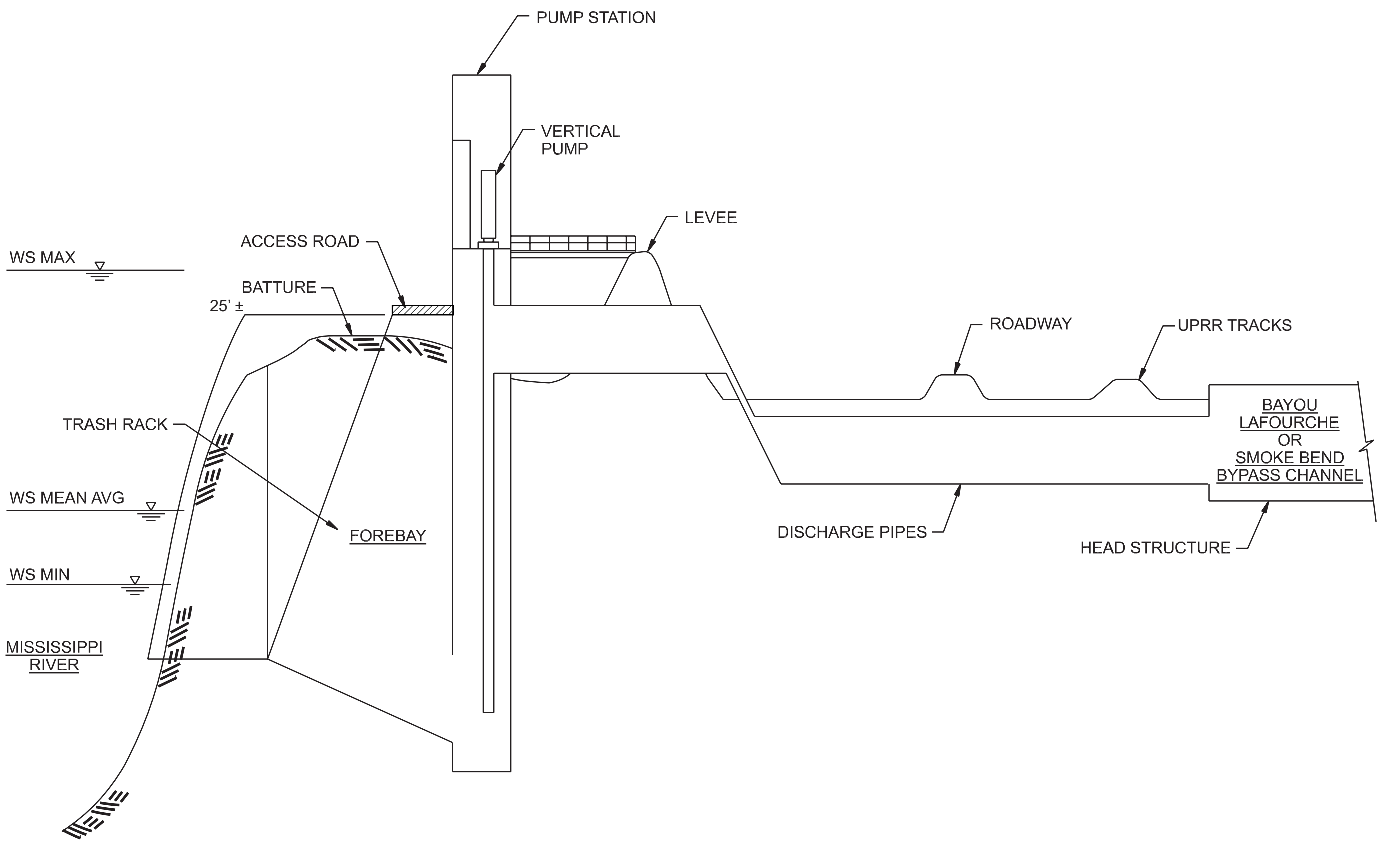
Regardless of the lower forebay velocities, material floating down the river (e.g., logs and garbage) will find its way into the forebay intake, and will need to be removed periodically. A log boom across the mouth of the forebay channel will assist in controlling and minimizing the amount of floating material that enters the channel when the river stage elevation is below the batture. When the batture is flooded, the need for a log boom or berm on the batture should be considered, but because the forebay channel will be flooded, floating material should continue down the river and pass over the forebay. When the batture is under water, it is more likely that heavy material and items being pushed along the batture by the river will fall into the forebay channel. A low berm on the upstream side of the forebay channel, to deflect some of the debris, will be evaluated during the 30 percent design.

A forebay intake limits access along the batture because there is an open channel from the river bank to the pump station structure. Depending on the elevation of the pump station discharge piping, access along the batture might be available between the pump station and the levee.

4.4 Discharge Alternatives

Discharge pipes will convey water from the pump station to the headwaters of the bayou for the Donaldsonville site or to the headwaters of the bypass channel for the Smoke Bend site. Because of the various physical features, all of the pump station arrangements considered for this Phase 1 design that must be crossed use discharge piping.

For facilities on the river side of the levee, the standard criterion provided by the USACE has been that facilities do not encroach on the 100-year floodplain elevation plus a 3-foot freeboard. Consistent with this criterion, the existing Donaldsonville pump station deck is at Elevation 24.7 feet (NAVD88), and the inverts of the pump discharge piping are at or above that elevation where they cross the levee. Discharge piping crossing the levee at or above



TYPICAL FOREBAY, RIVERSIDE PUMP STATION, THROUGH-LEVEE DISCHARGE PIPING

FIGURE 4-6
PUMP STATION PROFILE NO. 2
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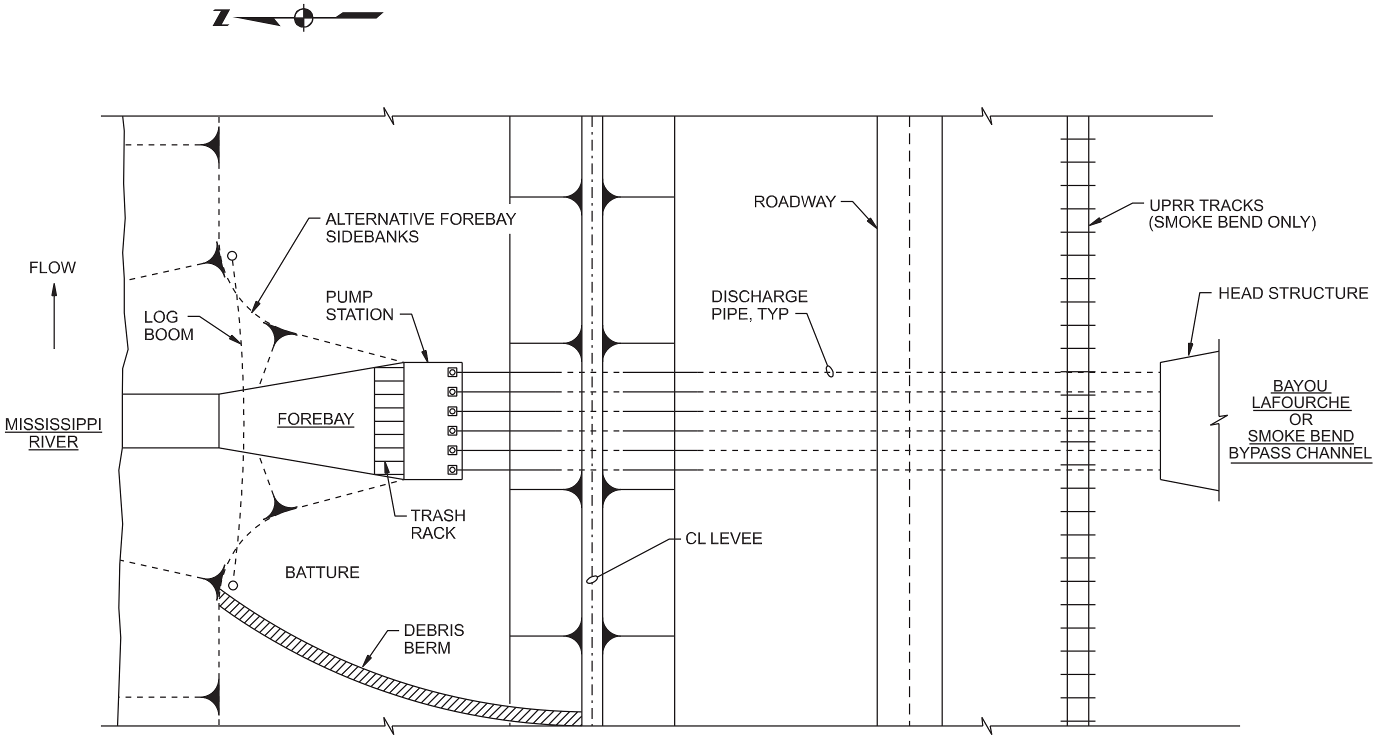

FOREBAY, RIVERSIDE PUMP STATION, THROUGH-LEVEE DISCHARGE PIPING

FIGURE 4-7
PUMP STATION SITE PLAN NO. 2
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this elevation is described as an "over-levee" discharge pipe alternative, depicted on Figures 4-4 and 4-5. The Phase 1 design also considers locating the discharge piping below the previously established criterion, but additional discussion and coordination with USACE and other agencies, such as the Mississippi River Commission, are required before a "through-levee" alternative will be undertaken. The over-levee configuration can be a pumped or siphoned discharge pipeline.

Microtunneling construction techniques are desirable for crossing the roadway and the railroad, and will eliminate or minimize the impact on the use of the thoroughfares. Additional coordination with the railroad owner and local agencies, both at the preliminary stages of design and during construction, will be needed to ensure that requirements are met.

Because of the operational flexibility of individual siphon action on each pump discharge, the discharge pipes are kept separate and not brought together in a common header pipe. Each discharge pipe was sized for a velocity of about 8 fps at design flows. Table 4-3 lists the discharge pipe sizes used for each nominal pump size. As final alternatives are developed and pump station flow rates determined, pipe size selections will be reviewed and optimized as appropriate.

TABLE 4-3
Pump and Discharge Piping Configurations
Mississippi River Reintroduction into Bayou Lafourche – Phase 1 Design Report

Individual Pump Size (cfs)	Discharge Pipe Diameter (inches)	Discharge Pipe Velocity (fps)
50	36	7.07
100	48	7.96
200	66	8.42
250	78	7.53
300	84	7.79
400	96	7.96

As the conveyance alternatives developed, two prominent groupings of discharge water surface elevations were noted as low-head (approximately Elevation 10) and high-head (approximately Elevation 20) groupings. For both of the groupings, it was possible that the pump discharge pipe could be at a higher elevation than both the inlet and outlet water surfaces and, therefore, the use of a siphon would reduce pumping costs. A vacuum system would assist with the practical operation of the siphon and would be particularly needed to start pumps when the river elevations are low, and to establish and maintain gravity siphoning when the river elevations are high.

4.4.1 Over-levee Discharge Piping

As shown on Figure 4-4, the over-levee discharge piping does not actually go over the levee. The discharge actually goes through the levee, but above the 100-year floodplain elevation. As shown on the figure, the levee is built up higher to maintain vehicle access over the pipes along the top of the levee and to provide adequate cover for the pipes. As the levee elevation increases, the width at the top of the levee must be maintained; therefore, the base of the levee must increase to maintain a consistent side slope.

4.4.2 Through-levee Discharge Piping

Discharge piping routed through the levee at an elevation below the 100-year floodplain would only occur through coordination with the appropriate agencies. Although it is anticipated that a siphon condition would still occur for the majority of the river stages, the lower discharge pipe invert would reduce the operational time to initiate the siphon, because the vertical pipe length and volume would be less.

Figure 4-6 depicts a through-levee discharge pipe at the lowest elevation recommended (approximately Elevation 20) so that the pipe trenching would not disturb native soils, which are assumed to be below the toe of the levee. According to the daily river elevations recorded since 1951, the river is below Elevation 25 about 94 percent of the time, and the river is below Elevation 20 about 81 percent of the time. Valves or some other means to shut down or control flow in the system will be needed when the river stage is greater than the highest point of the discharge pipe invert. Setting the discharge pipe invert at Elevation 25 would minimize the amount of time the system would have to rely on the valves to control flow to the bayou.

During construction of the discharge piping at a lower elevation, the levee will be compromised and will require a large cofferdam to maintain integrity during high water events. For a 1,500-cfs pump station, the levee excavation cofferdam is estimated to be 500 feet long and would need to connect into the existing levee. As part of this option, sheet pile can be left in place to provide some cut protection. The levee would be backfilled in accordance with USACE requirements.

4.5 Sediment Alternatives

4.5.1 Existing Sediment Sources

Sediment from the Mississippi River is carried through the pump station and deposited in the downstream channel depending on the type of soil material, water velocity, and other suspension characteristics. The existing pump station has no sediment basin. Since the pump station was constructed, sediment has accumulated in the channel. Typically, the types of soil particles in the water are sand, silt, and clay. Sand begins to drop out when velocities are less than about 2 fps. Silt and clay particles drop out given sufficiently slow water velocity and channel length. Reconnaissance of the existing channel suggested that sand, silt, and clay particles have been deposited through many reaches of the bayou. The shoreline contains many feet of silt- and clay-sized particles. Although no drilling has been done in the upper reaches of the bayou in Donaldsonville, it is likely that layers of fine sand have been deposited near the pump station outlet after the velocities have slowed.

Sediment deposition volume in the bayou is greatest when the water in the Mississippi River is at its highest concentration and the pump station is pumping the highest flow. Not all sediment in the water that flows down the bayou drops to the channel bottom. Some is resuspended in areas on the outside of river bends, where the velocity is high enough to cause scour. Some very small particles likely stay suspended until the water reaches the Gulf.

4.5.2 Sediment Facilities Downstream of Pump Stations

For the existing pump station, a sediment collection area could be constructed immediately downstream of the railroad bridge, where there appears to be sufficient land to widen the channel. This area is approximately 2.5 acres, of which 1.75 acres are occupied by the existing channel. For this area to be used as a sediment trap, the channel would have to be widened to slow the water velocity and maintain that velocity for a distance of 500 feet or more. This area would allow coarse and fine sand and some silt-sized particles to be deposited. Additional sediment characterization and laboratory testing will be required to estimate the volume of sediment entering the bayou.

At a new reintroduction facility, sediment will pass through the pumps. The volume and type will depend on the sediment characteristics at the pump intakes. A sediment basin could be constructed in the beginning portion of the open channel downstream of the discharge pipes. This facility would consist of a double-wide channel 500 to 1,000 feet long. Sand and silt would be deposited if the velocity of the water were less than 1 fps. The area would have to be sufficiently large to allow for 6 to 12 months of sand and silt accumulation so that cleaning could be scheduled once or twice a year. For both the existing and new reintroduction channels, access would be provided on the shoreline to allow for a clamshell, dragline, or excavator to remove sediment. This material would either be transported to a stockpile location or placed next to the channel. Material reuse would likely be for building fill or for distributing to agricultural lands. A site dedicated to storing sediment adjacent to the channel should be considered during the 30 percent design. The sediment could be pumped by dredge directly to the storage site.

4.6 Pump Station Alternatives

4.6.1 Rehabilitation of Existing Pump Station

The existing Donaldsonville pump station consists of four fixed-speed pumps, each with a nominal capacity of 100 cfs. The actual capacity of the station is less than 400 cfs because of age and actual operating heads (i.e., upstream and downstream water levels). The Bayou Lafourche LFWD operates the pump station to provide water for public consumption and industrial use along the bayou. Because the pumping speeds are fixed, the LFWD manually throttles the pumps to maintain the target downstream water levels. The existing pump station does not have automated controls.

Previous CWPPRA alternatives included rehabilitating the existing pump station to 340 cfs (closer to its original rating) and providing additional capacity by means of new and separate pumping facilities. A new issue to address is what rehabilitation, if any, is necessary for the pump station to be used with the bypass channel alternatives. It currently appears that one of the existing pumps might meet the discharge requirements for the bypass alternatives.

4.6.2 New Pump Station

Pump station locations on the river side of the levee have already been discussed in this section; multiple intake and discharge options are available for a river-side pump station. Figure 4-8 depicts a pump station on the land side of the levee, connected to the river with intake pipes that have an invert low enough to ensure that water will flow in sufficient volumes at low river elevations. Consequently, the intake pipes are deep and much lower than the toe of the levee. The most cost-effective construction option for these intake pipes is microtunneling. Further geotechnical investigations will determine whether the existing native material is acceptable for microtunneling. The geotechnical investigation will also determine whether the geology is stable enough that new tunnels would not weaken the levee or increase water movement under the levee. Cutoff walls across the intake pipelines can assist in reducing seepage along the pipelines.

The land side of the levee pump station design would need to address the "direct tap" into the Mississippi River. Valving or other means would need to be in place to protect against a system failure and unimpeded flow of river water.

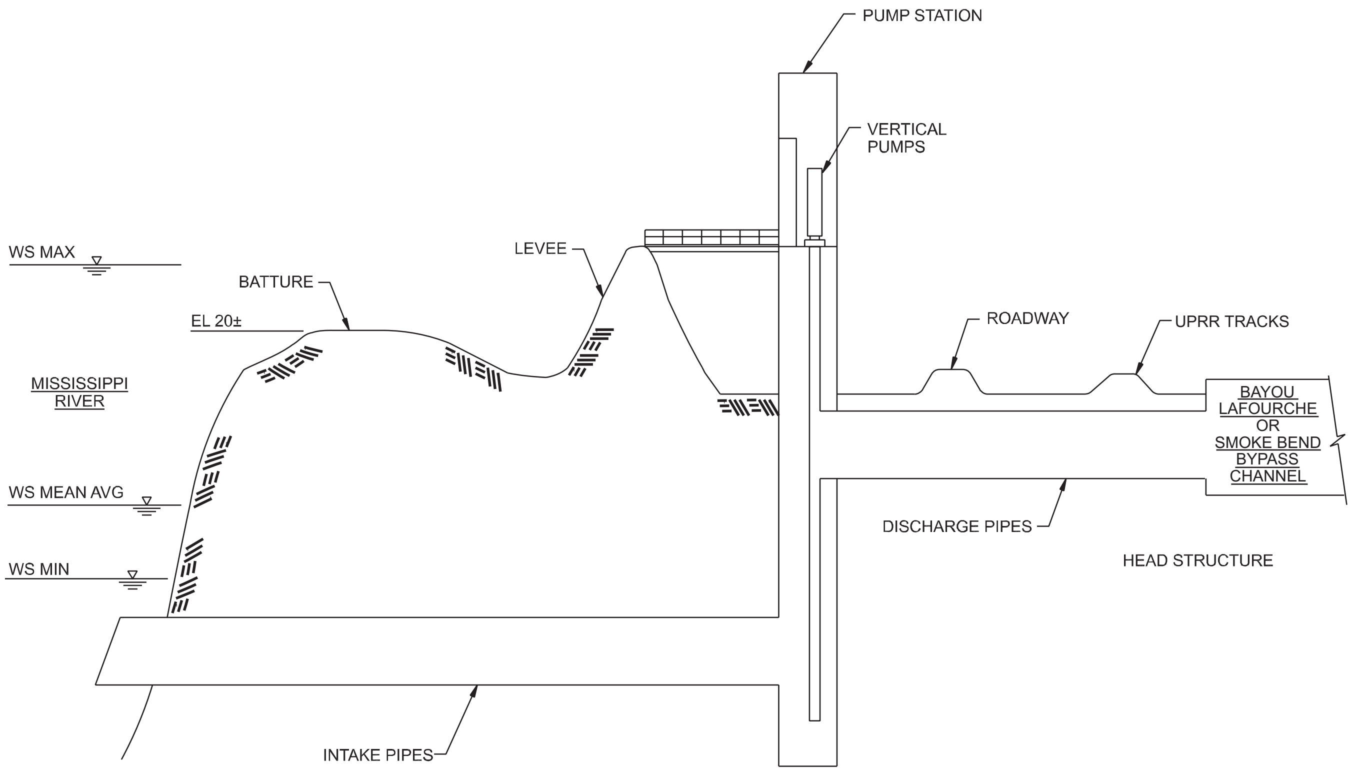
Pump Selection and Types

The pumps, intakes, and discharge piping were modularized for the Phase 1 design so that the pump station and diversion facility could accommodate the range of flows being evaluated as part of the conveyance analysis. Headloss calculations were based on a dedicated intake pipe and discharge pipe for each pump. Pump selections were based on distinct flows and two different total dynamic head conditions. Table 4-4 lists the flow and head conditions and the corresponding installed motor horsepowers for each selection. The total dynamic heads were based on friction losses through the dedicated piping and the static head required to lift water from the average low river stage elevation to the target water surface elevation in the bayou or the conveyance channel static head. The pumps typically provide more flow than the rated flow condition, because river elevations are usually higher than the average low river stage elevation.

TABLE 4-4
Pump Performance Points
Mississippi River Reintroduction into Bayou Lafourche – Phase 1 Design Report

Pump Size (cfs)	Installed Motor Horsepower	
	Low-head Condition	**High-head Condition**
50	125	225
100	250	400
200	400	800
250	500	1,000
300	800	1,500
400	1,000	2,000

Vertical propeller-type pumps were selected for the Phase 1 design because they are available with capacities up to 400 cfs. Typically, vertical pumps have pump columns with the propeller extended down into the water so that the inlet and impeller are always sub-merged. A drive line connects the propeller to the motor, which is located on the operating deck above. Depending on the final flow capacity of the pump station, submersible pumps



TYPICAL PIPED INTAKE, LANDSIDE PUMP STATION

FIGURE 4-8
PUMP STATION PROFILE NO. 3
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might be applicable. Submersible pumps have the motor and propeller directly coupled, with no extended driveline; because the propeller must be submerged, the motor is also submerged. A preliminary search of available submersible pumps indicated that the largest flow attainable with a submersible propeller pump is about 140 cfs.

The operating efficiency of the pumps was improved by incorporating a vacuum system into the pumping system. At pump startup in a siphon configuration, the pump must first lift water to top of the siphon or discharge piping. After the siphon is established, the operating head, or lift, of the pump is reduced and the pump operates at a lower head condition. With a vacuum system, the initial lift for the pump is reduced and the selected pump does not need to meet such a wide range of head conditions. Consequently, the pump will operate more efficiently. Detailed pump curve and sizing data are provided in Appendix G.

Depending on final alternative development, actual river stage elevations and discharge bay water surface elevations, diversion structure operation can vary widely. In general, it is anticipated that at higher Mississippi River stages, water will not be pumped, but only diverted to Bayou Lafourche. A typical annual cycle is estimated for 3 to 5 months of diverting flow with little or no pumping required. As the river stages lower, pumping will be required to maintain diversion flows into the bayou. At the higher river stages, the pumps will typically deliver higher flows of water than their designed capacity. Consequently, fewer pumps will be needed to meet the design flow at the higher river stage elevations. In addition, as the river stages get lower, each pump’s capacity will be reduced and more pumps will be operated to maintain the design flow conditions.

The Hydraulic Institute Standards were used to establish the approximate length and width dimensions of the pump station wetwell. The pump station dimensions on Figure 4-9 were based on a 1,500-cfs pump station with six 250-cfs pumps. The wetwell sizing dictated the dimensions of the pump station, but because of the magnitude of flows for this pump station, it is recommended that hydraulic modeling of the wetwell and intake system be conducted during the final design phases.

Pump Drive Unit Types

Because of their reliability and comparatively low maintenance cost, electric motor-driven pumps will be the only pump drive unit type considered. Although diesel or gasoline engine-driven pumps are used in remote locations and when pumps must operate in blackout conditions, the operation and maintenance costs of engine-driven units are significantly higher than for electric motors.

Both constant-speed and adjustable-speed electric motor-driven units will be considered during the design process. At a constant speed, a pump’s flow capacity will vary according to the difference in water surface elevations between the river and the bayou. Consequently, as the water surface elevations change, pumps will be turned on and off to match the design flow condition as closely as possible (the existing Donaldsonville pump station does this). If constant-speed pumps are used, the pump station might include two or three different pump sizes so the pumps can be used in combinations to match the design flow condition as closely as possible. An advantage of constant-speed motor controllers is that they do not require a climate-controlled environment, as do adjustable-speed motor controllers.

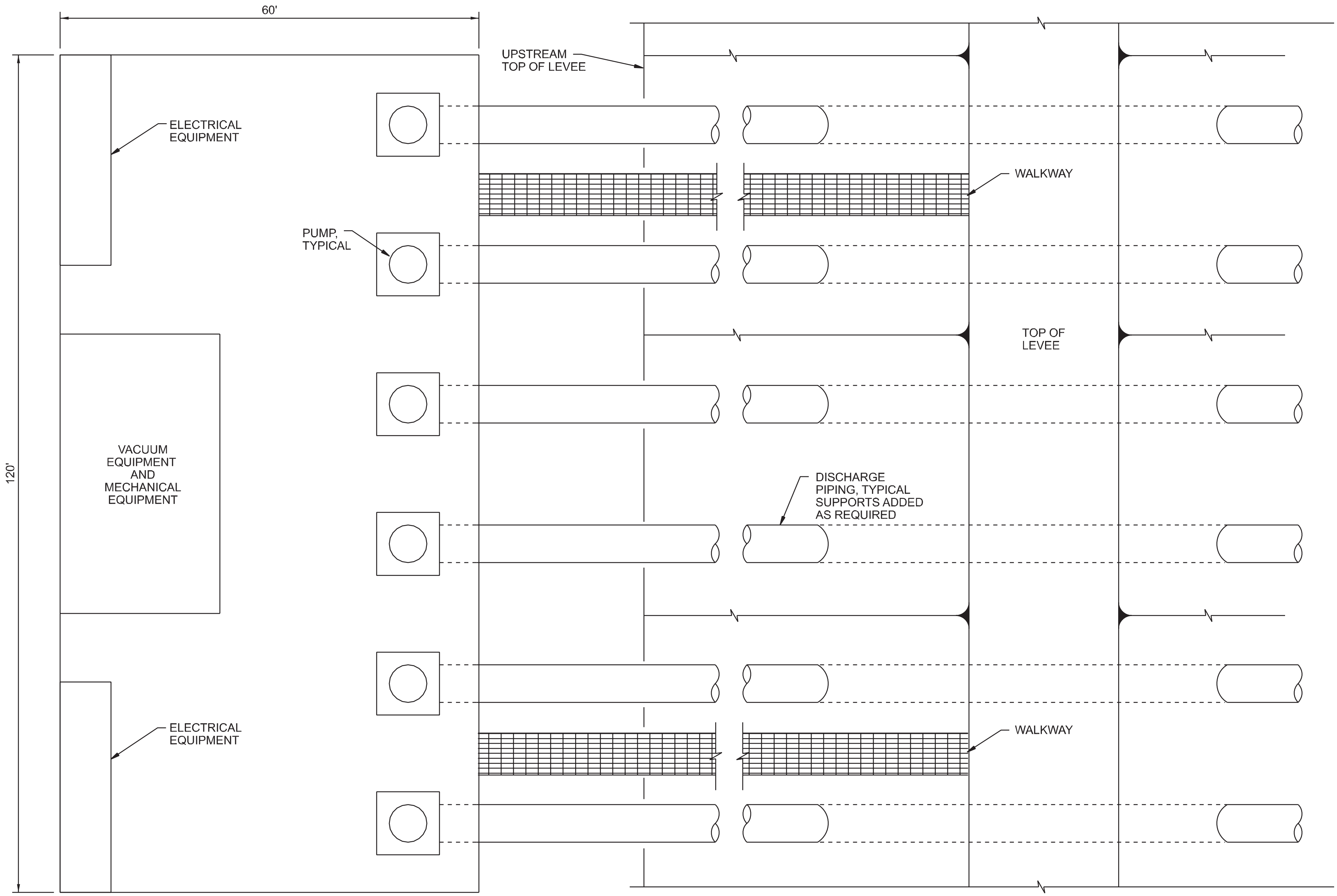

FIGURE 4-9
TYPICAL PUMP STATION PLAN
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Although the initial cost of adjustable-speed motor controllers is higher than constant-speed motor controllers, adjustable-speed controllers allow a wider range of flow rates from a single pump and reduce the need for different-sized pumps. Because the electronic components in an adjustable-speed motor controller are sensitive to excess heat, controllers should be housed in an air-conditioned space.

As the operational needs of the pump station are developed beyond the Phase 1 design, the need for adjustable-speed pumps, constant-speed pumps, or a combination of the two will be determined.

Electrical Power Supply

The local power supplier for all three sites is Entergy Power Company. Preliminary discussions with an Entergy representative for the Donaldsonville area indicated that adequate power is readily available with little to no distribution improvement required. The preliminary electrical loads for the pump station are great enough that the power will be supplied at either 2,400 or 4,160 volts.

The need for standby power for the pump station should be investigated in more detail during the 30 percent design. The concern is to maintain flow in the bayou during a power outage. A diesel engine-driven generator set would be sized to drive enough pumps to provide a limited flow of water down the bayou to keep it viable. Diesel fuel stored at the pump station would be adequate to operate the engine generator set for 12 hours. The existing pump station might be able to provide this function.

Pump Control Systems

Depending on the needs of the operators, the pump control system can be simple or elaborate. Remote monitoring can vary from a simple system providing only general alarm notification to a more elaborate system that provides continuous monitoring of all pump station variables. Monitored variables could include flow rates, pressures, levels, operating status of individual pumps, equipment run time, and specific alarm conditions.

Under normal conditions, automatic pump operation is not expected to be needed; therefore, it is assumed that the pumps will be operated manually. Pump control systems typically contain an automatic pump shutdown control for when the intake water level drops too low at the pump inlet. An automatic pump shutdown control should also be considered for a high bayou water level.

4.6.3 Check Structure Pump Station

The check structure pump station would be located in the bayou just upstream of the confluence of the new Smoke Bend conveyance channel. The higher flows added at the confluence from the new channel are expected to raise water levels above the stated target levels for the various alternatives. The check structure will prevent higher water levels in the upstream portion of the bayou, but will also require pumping capabilities to lift water in the upstream section to the higher downstream water levels.

The existing pump station is expected to typically add approximately 100 cfs of flow to the upper bayou to maintain water quality during all river stages. The check structure pump station has been estimated to need a pump capacity of 500 cfs because of storm events. The check structure pumps will be two adjustable-speed pumps rated for 250 cfs each. The pumps will be controlled to match incoming flows to the upper portion of the bayou and pump that flow to the higher downstream water level.

4.7 Diversion Structure Considerations

Various diversion structure alternatives have been discussed in this section. These diversion structures use a combination of siphons, pumps, and gravity diversions to reintroduce Mississippi River water into Bayou Lafourche. Different physical configurations can be used in various combinations. The main considerations for any of the pump station scenarios are as follows:

- Pump station location relative to the levee: river side or land side
- Pump station intake: pipe from river to pump wetwell or open channel (forebay) from river to pump wetwell
- Pump station discharge piping: invert of pipe crossing levee above 100-year flood stage or invert of pipe crossing levee below 100-year flood stage
- Pump type: vertical propeller with motor at pump deck or submersible propeller pump
- Drive unit type: constant-speed motor controller or adjustable-speed motor controller